bandwidth $2W$ and center frequency f_C: This filter has no effect on the received signal-related component, but does remove out-of-band noise power. As shown in the triangular-shaped signal spectrum (Figure 6.6), we apply coherent receiver to this filtered signal, with the result that the demodulated output contains noise that cannot be removed: It lies in the same spectral band as the signal.

As we derive the signal-to-noise ratio in the demodulated signal, let's also calculate the signal-to-noise ratio of the bandpass filter's output

$$\tilde{r}(t)$$

The signal component of

$$\tilde{r}(t)$$

equals $\alpha A_C m(t) \cos(2\pi f_C t)$ **.** This signal's Fourier transform equals

$$\frac{\alpha A_c}{2}\left((M(f+f_c)+M(f-f_c)\right)$$

(6.33)

making the power spectrum,

$$\frac{\alpha^2 A_c{}^2}{4}\left((|M(f+f_c)|)^2+(|Mf-f_c|)^2\right)$$

(6.34)

Exercise 6.12.1

If you calculate the magnitude-squared of the first equation, you don't obtain the second unless you make an assumption. What is it?

Thus, the total signal-related power in

$$\tilde{r}\,(t)$$

is

$$\frac{\alpha^2 A_c{}^2}{2} power\,(m)\,.$$

The noise power equals the integral of the noise power spectrum; because the power spectrum is constant over the transmission band, this integral equals the noise amplitude N_0 times the filter's bandwidth $2W$. The so-called received signal-to-noise ratio the signal-to-noise ratio after the de rigeur front-end bandpass filter and before demodulation equals

$$SNR_r=\frac{\alpha^2 A_c{}^2 power(m)}{4N_0 W}$$

(6.35)

The demodulated signal

$$\hat{m}(t)=\frac{\alpha A_c m(t)}{2}+n_{out}\,(t)$$

Clearly, the signal power equals

$$\frac{\alpha^2 A_c{}^2 power(m)}{4}.$$

To determine the noise power, we must understand how the coherent demodulator afects the bandpass noise found in

$$\tilde{r}(t)$$